A National Space Program for the United States

by
Dr. Hugh L. Dryden, Director
National Advisory Committee for Aeronautics

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My first airplane ride was in a Curtiss Eagle. It was one of the first of America's first trimotors, powered by Curtiss engines rated at 150 horsepower each. The brochure -- I still have it -- described the airplane as an "aerial limousine, with plywood cabin giving full protection from wind, and reduction of noise so as to permit conversation." Top speed was a little more than 100 mph and cruise was hardly 80mph. Nothing was said about range.

The Curtiss Eagle was obviously the ultimate in air transport. The brochure strongly suggested that thought. I was in no mood to challenge the obvious, because that was in 1919 and I had yet to learn how quickly and surely "ultimate" achievements in aeronautics are surpassed.

I must confess that in 1919, if anyone had predicted that 40 years later, commercial transport across country would be scheduled at 550 mph, well, I would have been skeptical. My inclination today, based on the

rapidity of yesterday's progress, is not to say things can't or won't happen. Besides, it has been far more satisfying to have been involved in some of the work that contributes to our progress in the realm of flight.

On April 2, President Eisenhower sent a message to the Congress, recommending that aeronautical and space science activities sponsored by the United States be conducted under the direction of a civilian agency, except for those projects primarily associated with military requirements. The draft legislation, sent to the Hill at the same time, centers responsibility for administration of the civilian space science and exploration within a new National Aeronautics and Space Agency, the nucleus of which will be the National Advisory Committee for Aeronautics.

The President has directed NACA to prepare the specific new space programs that NASA should undertake. He has also instructed NACA to present to the appropriate committees of the Congress a full explanation of the proposed legislation and its objectives.

These facts will explain why I am here today to discuss with you, in even the necessarily broad terms I shall use, "A National Space Program for the U.S.."

The need for the United States to assert its leadership in the fields of space technology is self-evident. For the record, however, I

should like to note the four reasons the President's Science Advisory Committee has listed as giving urgency and immediacy to our advancement in space technology. They are: (1) the compelling urge of man to explore the unknown; (2) the need to assure that full advantage is taken of the military potential of space; (3) the effect on national prestige of accomplishment in space science and exploration; and (4) the opportunities for scientific observation and experimentation that will add to our knowledge of the earth, the solar system, and the universe.

The space programs that must be promptly undertaken and vigorously carried to completion fall into three groups. First, there are projects for development of satellites and space craft such as those used for reconnaissance. These, clearly, are activities that are, and I quote from the language of the proposed legislation, "peculiar to or primarily associated with weapons systems or military operations." Such projects would be carried forward by the Department of Defense. Then, there are projects for development of satellites and space vehicles with the special capabilities required by the scientific community to probe the secrets of our solar system. Projects in this second category would be the responsibility of NASA. Finally, there are space projects that will be useful for both military operations and the data-gathering needs of civilian science.

Space projects in this third project will be reviewed jointly by the Department of Defense and the NASA to determine where responsibility

shall be lodged or whether the projects will be undertaken cooperatively. I, for one, might be concerned about the difficulties that could be expected to arise in these negotiations, were it not that since 1915 the military services and the NACA have worked together -- closely and harmoniously. The fact that we are moving into the new, unexplored areas of space merely increases the essentiality of this effective partnership.

Since the President's message on space, we have conferred frequently with responsible officials of the Department of Defense -- among them, the Deputy Secretary of Defense, Donald A. Quarles; ARPA Director, Roy W. Johnson, and ARPA, Chief Scientist, Herbert York. On both sides there has been evident a firm resolution that the military and civil segments of our space program be so administered that taken together they are of maximum benefit to our country.

As our exploration of space proceeds, I expect we shall find that most of the progress made in the technology will be applicable to satellites and space craft whether they are operated for military or civil purposes. My confidence on this point is based on the knowledge that in aeronautics, the research advances made in aerodynamics, propulsion and structures have been promptly used, first by the designers of military airplanes and then by the builders of commercial aircraft. The research and development performed under military auspices will be valuable in

furthering our space exploration for civilian purposes. The flow of useful information in the opposite direction will be similarly beneficial.

Over the past 43 years, the research activity of the NACA has been directed toward solution of the problems of flight. Until the end of World War II, these programs were focused mainly on problems peculiar to airplanes. Since then, we have been working increasingly to provide information useful in the design of missiles. Today, more than 50 percent of the effort of our 8,000 scientists, engineers and supporting personnel is applicable to missiles, satellites and space craft.

As stipulated in the draft legislation, the NASA will, and I quote, "plan, direct, and conduct scientific studies and investigations of the problems of manned or unmanned flight within or outside the earth's atmosphere with a view to their practical solution." Beyond this responsibility, study of the problems of flight, the bill provides that NASA shall develop, test, launch, and operate aeronautical and space vehicles, and that it shall arrange for participation by the scientific community in the planning of scientific measurements and observations to be made through use of aeronautical and space vehicles; and conduct or arrange for the conducting of such measurements and observations; and provide as appropriate for dissemination of the data collected.

The first of these new responsibilities over and beyond today's functions of NACA -- the development, testing, launching and operation of

aeronautical and space vehicles -- I wish to discuss in more detail a little latter. Respecting the second, it is imperative that the best scientific judgement available be employed to determine our space science objectives, and to this end it will be necessary that NASA work most closely with the National Science Foundation and our National Academy of Sciences. Again, as instructed by the President, we have already begun discussions with these bodies, as well as other governmental and non-govermental bodies to insure participation by the scientific community in the planning and coordination of the scientific programs for the use of space vehicles in civilian science.

Much has been said in recent months about these civilian science programs. I should like now to quote several scientists about the kind of fundamental, new information in their specialties that use of space vehicles can be expected to provide. This type of information, I might add, can be obtained only from positions out in space.

First, the statement of a geophysicist: "Observations of the man-made satellites will lead to important conclusions as to the precise shape of our planet. The plotting of the trajectories of a number of artificial satellites will finally enable us to determine the exact configuration of the earth, an extremely important element in the study of the origin, history and structure of our planet. By knowing the satellites' speed we shall be able to calculate precise measurements of the distances between

various points on the globe, thus making the present data more accurate.

"Satellites open new avenues for research in all the earth sciences -- gravimetry and geochemistry, geodesy and geophysics, seismography and hydrology. They will give us important information on the composition of cosmic dust that floats through interstellar space. Science has thus far merely guessed at its nature and properties, but the satellite laboratory will afford the possibility of undertaking a study of this problem from stage to stage. The supposition that cosmic dust is the material out of which planets are formed testifies to the importance of such a laboratory."

Next, I quote a meteorologist: "Air masses that form above ocean areas often determine the weather of land areas. Unfortunately we know so little about these great wastes of water which cover two-thirds of the globe that we know no way to forecast devastating typhoons and tornadoes. Immeasurably broader possibilities for study of the upper reaches of the atmosphere and of its lower regions where weather is made are opened by the creation of the man-made satellite.

"It will be possible to obtain detailed information about the movement and distribution of clouds throughout the globe and, consequently, of the air currents over most of its surface. It is of great value in advancing studies of the general circulation of the terrestrial atmosphere and creating physically substantiated methods for long-range weather forecasts.

"To investigate the complex movements and changes in the atmosphere we must know the earth's albedo, the quantity of energy the earth reflects into space. Satellite observations will supply us with this vitally necessary information. They will also fill in the very scanty data we now have on the density of air at high altitudes, the interaction of the atmospheric layers, and supply other such information with which we can accurately determine the laws of weather formation.

"In addition to having satellites circle the earth at altitudes of several hundred miles, it is desirable to set them spinning at lower altitudes. While these laboratories probably will not function long, they nevertheless can furnish data on the atmosphere around the earth that cannot be obtained from any other source."

My third quotation is from a physicist: "Investigations of diurnal variations, magnetic storms and the phenomena connected with them led scientists to assume that the external magnetic field may be due to systems of electric currents existing beyond the earth. The most likely place where such currents can originate is the ionosphere -- those layers of atmosphere which contain a large number of electrically charged particles. The existence of sources of a magnetic field in the ionosphere has been confirmed by direct magnetic measurements made with rockets. It is also assumed that currents may exist beyond the ionosphere. The source

of extra-ionospheric currents may be the charged particles, corpuscles, emitted by the sun, captured by the earth's magnetic field and revolving around the earth in the plane of its magnetic equator.

"Measurements made on satellites will help to verify whether the streams of solar particles are neutral or consist of electrically-charged particles of any given sign. Satellites will also help to verify the existence of extra-ionospheric currents, to obtain data on the ionospheric system of currents, and extend our knowledge of the main part of the magnetic field created by the sources within the earth".

"In studying celestial bodies, we astronomers have always been enormously handicapped because our observatories and scientific stations are at the bottom of the air ocean which envelops the earth, an ocean hundreds of miles deep. We have dreamed of observatories outside the atmosphere and the satellites have brought our dreams closer to reality.

"Now we can confidently predict the construction of satellite observatories within a few years which will circle the earth at an altitude of several thousands of miles and transmit scientific data from interplanetary space. One of the next steps is a rocket capable of penetrating beyond the sphere of terrestrial gravitation, of reaching the vicinity of the moon and circumnavigating it. Such a rocket would give us a wealth of information on the nature of lunar terrain and the structure of the dark side of the moon that is not visible from the earth."

And, finally, this quotation from an astrophysicist: "Cosmic rays travel for countless light years to reach the earth. The energy of particles of cosmic radiation can be expressed only in billions and tens of billions of electron volts. The energy of some particles is even millions of times greater. Research on the how and the where of the original processes which result in creating cosmic rays should be conducted beyond the earth's atmosphere. Otherwise secondary cosmic radiation produced in the atmosphere can be mistaken for primary radiation.

"The satellite laboratory will open new opportunities for study by elminating the distortions produced by the earth's atmosphere. It will be possible to classify the cosmic rays in greater detail according to their mass and energy. This in turn will enable us to find out the mechanism of their origin in the far depths of the cosmos and in our solar system as well.

"It is not unlikely that experiments conducted with the satellite as a vehicle for our instruments will lead to the discovery of new, unknown types of cosmic rays. Various data received from the cosmic ray laboratory above the atmosphere can provide us with an incomparably greater knowledge of the universe than we now have."

These comments about the benefits to civilian science that will result from good use of space vehicles sent on data-gathering missions

were made by members of the Academy of Sciences. I should be more specific: by members of the Academy of Sciences of the Union of Soviet Socialist Republics. The Russians are stressing the peaceful uses of space technology as positively and as widely as they can among the nations of the world. My quotations were from a recent issue of the handsome, Life-size magazine -- USSR -- published in well-written English and circulated throughout the United States.

The Russians aren't talking about military missions they propose to assign to their Sputniks. This fact serves to emphasize what we already know -- that in addition to being a new tool of great value to science and to the military, the space vehicle is a device that can be used to great advantage in the vitally important use of psychology and propaganda on a global scale.

Now I should like to return to consideration of the responsibilities of NASA for development, testing, launching, and operation of aeronautical and space vehicles. Over the years, NACA has concentrated for the most part on flight problems in the fields of aerodynamics, propulsion, and structures and structural materials. These are the areas where the NACA has the technical competence and the research tools. Flight into space requires that great effort be devoted also to such problems as electronics, guidance, and physiology or human factors.

It would, of course, be possible for NASA to establish new research centers for study of problems in these last-named areas. Such a procedure would be very costly. Trained people to accomplish the work would have to be recruited; almost certainly they would have to come from scientific and engineering organizations already engaged in work of importance to the national interest. Even more critical would be the passage of months and years before the new laboratories could begin producing information vital to the space programs.

A far wiser course, I believe, will be for NASA to make effective use -- on a contract basis -- of teams of experts and laboratory facilities already in being. Here in Southern California, there are such facilities. As a single example, I would name the Jet Propulsion Laboratory of the California Institute of Technology.

NASA will have to develop new space vehicles. Enormously powerful rocket motors will be required for these space craft; they may be even larger than those required for presently contemplated military missile or space missions. It would be possible for NASA to build the organization and the facilities for such space vehicle and motor design and construction. But again, such action would be very costly and much additional time would be required. It is preferable that design and construction of

these space vehicles and motors be performed, on contract basis, at existing facilities. In such cases, sponsorship might be either by NASA independently or jointly with the Department of Defense.

I am sure that our aircraft industry, so much of which is located in Southern California, is more than casually interested in who may be asked to build the space craft and rocket motors for the civilian program of space exploration and exploitation. One obvious answer is that the organizations best qualified will get the jobs. I would make further observation that when changing military requirements called for production of ballistic and other missiles to supplement the capabilities of the bomber, the aircraft industry demonstrated that its design and production teams were singularly qualified to develop and build missiles.

In recent weeks, to go still further, I have become familiar with many of the satellite and space craft projects proposed by American industry. I haven't counted them. Some say the number is 60. With some poetic license I have put it nearer 200. At any rate, and this is pertinent here, most of these projects are suggested by members of the aircraft industry. So long as the technical and production competence of the industry can keep up with the exploding needs of the space program, the same reasons that discourage construction of new laboratories and scientific teams to perform work that can be done by in-being research organizations would apply to space craft development and construction.

The space programs we will be proposing soon for NASA accomplishment are three-fold in scope. First, there must be adequate research effort on space technology problems. Then there must be development and use of unmanned vehicles capable of carrying the desired scientific data-gathering apparatus. Finally, there must be development and orderly use of man-carrying vehicles in the exploration of our solar system. The three parts of our program must be skillfully integrated and coordinated. Just as rapidly as research can provide the necessary information, we should use it in developing -- and using -- both automated and manned vehicles with greater performance and sophistication.

I should like to emphasize the essentiality of our planning a space program that will be adequate to our needs as a nation. The size of the program and the vigor with which it is carried out must be firmly established and ratified by the Administration, the Congress, and finally, the American people. In making these decisions, we must keep in mind that today Soviet Russia is working harder than we to achieve pre-eminence in the conquest of space.

We must understand that the kind and magnitude of space program that our national interest requires will cost hundreds of millions of dollars each year for many years to come. I know that some knowledgable people fear that although we might be willing to spend a couple

of billions for space technology in 1958, because we still remember the humiliation caused by the appearance of the first Sputnik last October, next year we will be so preoccupied by color television, or new style cars, or the beginning of another national election campaign that we'll be unwilling to pay another year's installment on our space conquest bill. For that to happen -- well, I'd just as soon we didn't start.

Fortunately, for the sake of our children's future if not for the protection of our own skins, I don't think we're that grasshopper-minded. This past week I was privileged to appear before the Select Committee on Astronautics and Space Exploration of the House of Representatives. Repeatedly the members of that Committee reflected the wish that I am sure is that of the entire nation, that we determine what is necessary to do to reach our goals in space and then get on with the job.

As a nation, we have the scientific and technical competence. We have the resources to pay the bill. We can and we must succeed in finding our destiny in space.

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